METHOD AND DEVICE FOR CONTROLLING FOIL TENSION DURING THE MANUFACTURE OF WOUND ELECTRICAL CAPACITORS

Specification

[0001] The invention relates to a method for controlling the foil tension[1] during the manufacture of wound electrical capacitors in which the foil is run over a swiveling lever (dancing roller) that is loaded by a torque at the axis.

[0002] During the manufacture of electrical capacitors, it is necessary to preset and control the foil tension because rejects, quality and service life of the capacitors are affected, inter alia, by the foil tension.

[0003] Until now, this problem was solved by loading a swiveling lever (dancing roller) with spring force, weight, pneumatically or electrically by rotating-field magnets (asynchronous motor with permanent slip).

[0004] All of the methods mentioned have one or more of the following disadvantages: The foil tension varies by nature to a greater or lesser degree; adjustment of the desired foil tension requires considerable effort and is reproducible only to a limited extent; occurrence of significant frictional forces; high moments of inertia result in dynamic forces; changing the foil tension during a winding operation, for example, using control computers, is impossible or extremely complicated.

[0005] It is therefore an object of the present invention to provide a method and device for controlling the foil tension during the manufacture of wound electrical capacitors, avoiding the difficulties pointed out above.

---

[1] **Translator's note: The original German document speaks of "Folienzug", which has been translated as "foil tension" in the English document. Please note that the German word "Folie" can be translated into English as "film" or "foil". In the context of wound capacitors, different types of construction are in use, which, depending on the materials used, are referred to as "film capacitor", "metallized film capacitor", "film/foil capacitor", "foil capacitor", etc. In this connection, it appears that "film" refers to plastic material, which may be coated with metal, whereas "foil" refers to pure metal. Since the materials used are not further specified in this patent application, it is not clear whether the translation "foil" is the best choice here.**

[0006] In a method of the type mentioned at the outset, this objective is achieved according to the present invention in that the torque is generated by a DC shunt motor which is supplied with current via two highly flexible leads that are soldered precisely opposite each other to the commutator.

[0007] According to the present invention, the objective is also achieved by a device having a DC shunt motor which is used for generating the torque, and which is supplied with current from a constant-current source and has two highly flexible leads for current supply that are attached precisely opposite each other to the commutator of the motor.

[0008] In an advantageous embodiment, the swiveling lever has a symmetrical design.

[0009] The present invention will be explained by the following exemplary embodiments.

[0010] In the associated drawing,

[0011] Figure 1 shows a device having an asymmetrically designed swiveling lever; and

[0012] Figure 2 shows a device having a symmetrically designed swiveling lever.

[0013] Figure 1 shows a swiveling lever 1 which, at the lower end, is provided with a roller 2 over which is run foil 3. Swiveling lever 1 is rotatably mounted on an axis 4 which is acted upon by a constant torque M_D.

[0014] In Figure 1, it is shown that swiveling lever 1 can be deflected by the angle $\pm \alpha$ to change foil tension F, foil tension F being changed to foil tension $F = f(\pm \alpha)$.

[0015] Given an angle $\alpha = 0°$, i.e., a right angle between foil 3 and swiveling lever 1, it holds that
$F = M_D/2r$.

[0016] When deflecting swiveling lever 1 by the angle α, the following is obtained by resolution of forces:

1) $F = M_D/(2r \cdot \cos \alpha)$.

[0017] It follows from (1) that when swiveling lever 1 is deflected from the reference position by the angle α, foil tension F is increased by the factor $1/\cos \alpha$.

[0018] If torque M_D is generated by a modified DC motor, it is no longer constant. In this context, the motor can be designed as a shunt motor, which is excited, for example, by permanent magnets. In this case, it holds that $M_D = I \cdot K$ (K = motor constant) within the rated speed range, including standstill.

[0019] If now the two carbon contacts of the commutator are removed, and instead two highly flexible leads are soldered precisely opposite each other to the commutator, the above relation is no longer valid without restriction. If the armature position of maximum torque is defined as the zero position, the relation is still valid in this position, and only in this position.

[0020] When the armature is deflected from the zero position by the angle α, then, in addition, it holds that:

2) $M_D = I \cdot K \cos \alpha$

[0021]. Inserting (2) into (1) yields:

$F = (I \cdot K \cos \alpha)/(r\cos \alpha)$.

[0022] From this, it follows that

$F \sim I$

i.e., foil tension F is proportional to armature current I for each actually occurring angle α.

[0023] If this current is generated by a constant-current source, the foil tension is constant. The current indicator can be directly calibrated in N. This current, and thus foil tension F, can be controlled very easily via an interface using a control computer.

[0024] Figure 2 shows a swiveling lever 5 which has a symmetrical design and is rotatable about a centrally arranged axis 6 Located at both ends are rollers 7, 8 over which is run foil 9. The adjustment of foil tension F is accomplished via the torque M_D acting upon axis 6.

[0025] Using the embodiment shown in Fig. 2, the influence of gravity on swiveling lever 5 is eliminated.

[0026] For purposes of technical implementation, the shunt machine is advantageously designed in such a way that the permanent magnet is accommodated in the rotor.

[0027] The advantages are:

- the moment of inertia is further reduced
- no need for movable power supply conductors
- the achievable torque is about 5 times higher for a given size